

## **ASSEMBLY TO CONNECT PROSTHETIC TEETH TO DENTAL MODELS**

### **Related Applications**

This application claims priority to Provisional Patent Application No. 60/438,304, of the same title, filed January 7, 2003, and designated Attorney Docket No. 12648P.

### **Field Of The Invention**

The invention is an assembly that connects prosthetic teeth to dental models. The assembly forms a two part analog pin that snaps into a sleeve. Also disclosed are kits for installing the assembly, dental models that contain the assembly, and methods for making dental models that contain the assembly. The assembly expedites the connection and separation of prosthetic teeth to and from dental models and can be employed in conjunction with dry set dowel pins.

### **Description Of Related Art**

The present invention improves on a technology described in three patents issued to the same inventor, namely, U.S. Patent Nos. 5,658,147, 5,788,494 and 5,934,906. Priority to the applications leading to these patents is not claimed. However, these patents are incorporated herein by reference.

It is known in the art to implant replicated teeth that have been removed or are otherwise missing. A replicated tooth designed for implantation is referred to herein as a "prosthetic tooth." Often, a single prosthetic is made to replicate multiple adjacent missing teeth. Accordingly, it should be understood that the phrase "prosthetic tooth" as used herein also embraces the replication of multiple teeth.

A prosthetic tooth generally comprises a hollow core, surrounded by a metal abutment which, in turn, is surrounded by a ceramic facing. The ceramic facing is shaped to replicate, as nearly as possible, the missing tooth. The core of the prosthetic tooth is open at both ends. Surrounding one end of the core is an engaging head with a geometric recess.

It is known in the art to attach a prosthetic tooth to a patient's jaw using an "implant fixture" that is embedded in the patient's jaw by osseointegration. Implant fixtures generally comprise an internally and externally threaded hollow tube with an opening at one end. Surrounding the open end of the implant fixture is an engaging head with a raised geometric abutment. The shape of the abutment corresponds, inversely, to the shape of the recess on the engaging head of the prosthetic tooth. To accomplish attachment, the recess on the

1 engaging head of the prosthetic tooth is placed around the abutment on the engaging head of  
2 the implant fixture. This provides a non-rotating friction fit. Then, a headed screw is passed  
3 through the core of the prosthetic tooth and rotated into the internal threads of the implant  
4 fixture until the screw head rests on a ridge inside the core of the prosthetic tooth. This  
5 provides a more permanent attachment. Afterwards, the exposed opening in the prosthetic  
6 tooth is capped with porcelain, or some other material, so that it is not readily apparent to the  
7 naked eye.

8 It is known in the art to facilitate the design of a prosthetic tooth with an accurate  
9 replica of the patient's teeth and gums called a "dental model." The dental model usually  
10 includes some form of analog, generally called an "analog pin," that replicates the initial  
11 engaging portions of the implant fixture. "Initial engaging portions" means the raised  
12 abutment on the head of the implant fixture and a portion of the internal threading in the  
13 implant fixture.

14 Dental models containing analog pins are typically created by a multi-step process.  
15 First, a coping is fitted onto an implant fixture that is, in turn, affixed to a patient's jaw by  
16 osseointegration. To coping and implant fixture fit together because, like a prosthetic tooth,  
17 the coping contains an engaging head with a recess that inversely corresponds to the  
18 abutment on the engaging head of the implant fixture. Second, an impression material is  
19 placed around a selected region of the mouth, including the coping, and allowed to set.  
20 Setting binds the coping to the impression. Third, the set impression, with bound coping, is  
21 removed from the patient's mouth and connected to an impression tray to provide a negative  
22 model of the selected portion of the patient's mouth. Fourth, an analog pin is friction fit to  
23 the engaging head on the coping. To accomplish this friction fit, the analog pin has an  
24 engaging head that mimics the engaging head of the implant fixture and, accordingly, fits  
25 into the recess on the head of the coping. In addition, the analog pin contains an internally  
26 threaded hollow that replicates at least a portion of the internal threading in the implant  
27 fixture. Fifth, die stone is poured into the dental impression and permitted to set. When the  
28 die stone sets, it forms a dental model that has an analog pin affixed therein. Sixth, the dental  
29 model is removed from the impression. As a result of the process, the engaging head on the  
30 analog pin is exposed on the tooth bearing surface of the dental model at the exact point  
31 where attachment of a prosthetic tooth is desired.

1 During the design process, the prosthetic tooth is repeatedly installed on, and  
2 subsequently removed from, the dental model. This is necessary to insure that the prosthetic  
3 tooth will function and appear naturally in the patient's mouth. Generally, installation and  
4 removal has been accomplished in a manner identical to final installation and removal on an  
5 implant fixture. In other words, the engaging heads on the prosthetic tooth and analog pin  
6 are contacted and then a headed screw is passed through the hollow core of the prosthetic  
7 tooth into the internal threads of the analog pin. Often, a specially designed screw driver is  
8 required. Accordingly, attachment, removal and reattachment of the implant has been a  
9 laborious and time consuming process.

10 The invention described in U.S. Patent Nos. 5,658,147, 5,788,494 and 5,934,906  
11 greatly simplified this process. As described therein, an assembly comprising an analog pin  
12 and a sleeve is utilized. The prosthetic tooth is screwed into the analog pin. The analog pin,  
13 in turn, slides through, and snaps into, the sleeve. The sleeve, in turn, is permanently fixed to  
14 the dental model. Accordingly, removal of the prosthetic tooth from the dental model no  
15 longer requires unscrewing a screw. Instead, the analog pin, and attached prosthetic tooth,  
16 quickly snap out of, and back into, the sleeve as a single unit. When the prosthetic tooth is  
17 removed from the dental model, the analog pin remains attached and provides a handle to  
18 better manipulate the prosthetic tooth during finishing.

19 Unfortunately, the assembly described in U.S. Patent Nos. 5,658,147 and 5,788,494  
20 and 5,934,906, like prior art analog pins, is not well adapted for use with dry set dowel pins.  
21 Dry set dowel pins are a device commonly utilized in the dental industry to facilitate the  
22 design of tooth restorations, as opposed to tooth replacements. Dowel pins are a means for  
23 supporting sectioned dies on a dental model. Each section, or die, consists of one or more  
24 replicated teeth connected to a base in the dental model by the dowel pins.

25 The conventional process for setting dowel pins is called "dry set" and involves a  
26 number of steps. First, die stone is poured in excess into a dental impression previously  
27 made from the patient's mouth. Once the die stone sets, it creates a "die model." Second, the  
28 die model is removed and its underside is trimmed and leveled – using, for instance, a  
29 grinding stone. This produces a smooth flat surface on the bottom of the dental model close  
30 to the underside of the replicated teeth. Third, holes are drilled into the bottom of the dental  
31 model. The holes are positioned immediately below the portions of the die model that

1 replicate teeth in need of restoration. Fourth, dowel pins are fastened into the holes. Dowel  
2 pins generally comprise a fastening portion that is relatively short, rough, and thin and a pin  
3 portion that is relatively long, smooth, and tapered. The dowel pins fit into a dowel sleeve.  
4 The fastening portion is inserted into the dowel pin holes and attached, for example, by an  
5 adhesive. Once fastened, the pin portion projects away from the underside of the die model.  
6 The pin portion of the dowel pin is then sheathed into the dowel sleeve. Fifth, the base is  
7 formed. This is done by pouring base stone into a base former (or reservoir) and inserting the  
8 die model, sleeved dowel pins first, into the base former. The base sets underneath the die  
9 model and around the dowel sleeves. Sixth, the die model is lifted off the base. Removal  
10 can be facilitated by using different types of die stone in the model and base and/or  
11 positioning a thin intermediate plastic layer between the die stone and base prior to pouring  
12 the base. Upon removal, the dowel pins slide out of the dowel sleeves - which remain fixed  
13 to the base. Seventh, and finally, the desired sections, or dies, are cut. Each die in the dental  
14 model consists of one or more replicated teeth. Each die in the dental model has dowel pins  
15 extending from the underside to permit proper positioning and easy placement and removal  
16 from the base.

17 Analog pins, including those described in the assemblies of U.S. Patent Nos.  
18 5,658,147 and 5,788,494 and 5,934,906, are not well adapted for use with dry set dowel pins.  
19 In contrast to dry set dowel pins, analog pins are positioned prior to casting and remain  
20 exposed on the tooth bearing surface of the dental model. Accordingly, when the die model  
21 is trimmed and leveled close to the underside of the replicated teeth, as required to dry set  
22 dowel pins, the previously positioned analog pins are severed or otherwise destroyed.

23 This is not to say that there is no means known in the art that permits the use of  
24 dowel pins in conjunction with analog pins. In fact, FIG. 3 in U.S. Patent Nos. 5,658,147  
25 and 5,788,494 and 5,934,906 show that the present inventor has successfully created such an  
26 arrangement. However, in such cases, the dowel pins are set using a process called "wet set."  
27 This process is more complicated, more prone to error, and less familiar to dental  
28 practitioners than the aforementioned "dry set" process.

29 In the wet set process, dowel pins are inserted into the die stone before the die stone  
30 sets, e.g., while the stone is still wet. There is no trimming and/or leveling prior to  
31 positioning the dowel pins. Accordingly, extreme care must be taken not to place the dowel

1 pins too deep or too shallow in the die stone, or in the wrong position, or at the wrong angle.  
2 Even experienced practitioners make mistakes using the wet set process.

3 Accordingly, it would be advantageous to develop an assembly that permits an analog  
4 pin to be used in conjunction with dry set dowel pins. This would enhance the ability to  
5 design prosthetic teeth and tooth restorations for a single patient on a single dental model.  
6 Additionally, it would be desirable to design such an assembly in a manner that utilizes the  
7 quick connect features of the assembly described in U.S. Patent Nos. 5,658,147 and  
8 5,788,494 and 5,934,906.

### 9 **Brief Summary Of The Invention**

10 The invention is directed to an assembly that connects prosthetic teeth to dental  
11 models. The assembly forms a two part analog pin that snaps into a sleeve. Also disclosed  
12 are kits for installing the assembly, dental models that contain the assembly, and methods for  
13 making dental models that contain the assembly. The assembly expedites the connection and  
14 separation of prosthetic teeth to and from a dental model and can be employed in conjunction  
15 with dry set dowel pins.

16 The principle components of the assembly are as follows: (i) an engaging head; (ii) a  
17 tail; and (iii) a sleeve. Optionally, but preferably, a pin relief is also employed.

18 The engaging head can be divided into upper, middle and lower portions. The upper  
19 portion contains a raised abutment and an opening and mimics the engaging head on an  
20 implant fixture. The middle portion contains an internally threaded hollow tube that extends  
21 to the opening and mimics at least a portion of the internal threads on an implant fixture. The  
22 lower portion contains a vertical projection.

23 The tail comprises a pin attached to the lower portion of the analog engaging head.  
24 When attached, the tail projects away from the analog engaging head. Connection may be  
25 accomplished by a variety of means, including friction fit mechanisms, interlocking spiral  
26 threads, and/or an adhesive. The engaging head and tail are designed to connect together to  
27 form an two part analog pin.

28 The sleeve comprises a hollow tubular body, open at both ends, that has a shorter  
29 axial length than the two part analog pin. The sleeve fits around the lower portion of the  
30 engaging head and most of the tail of the two part analog pin.

1           Additionally, and preferably, the assembly contains a pin relief. The pin relief  
2 contains a hollow that fits around the lower portion of the tail. The pin relief serves to lock  
3 the two part analog pin in place.

4           Kits for installing the assembly into a dental model include the aforementioned  
5 engaging head, tail, sleeve and pin relief. The kits additionally contain a cavity preserver.  
6 The cavity preserver is a soft, hollow, tubular body, generally made of rubber, open at one or  
7 both ends. The cavity preserver is longer than the lower portion of the engaging head. The  
8 cavity preserver is designed to fit around the lower portion of the engaging head prior to  
9 casting a model.

10          Dental models that contain the assembly contain the two part analog pin formed by  
11 attaching the tail to the engaging head. The two part analog pin is snapped into a sleeve that  
12 is, in turn, fixed to a cast base. Preferably, the dental models also contain a pin relief. One  
13 of the advantages of the invention is that the dental models may also contain one or more  
14 sectioned dies connected to a base by one or more dry set dowel pins.

15          Dental models that contain the assembly can be produced by a method comprising at  
16 least the following steps:

- 17           (i)     positioning the engaging head onto a coping in a dental impression;
- 18           (ii)    casting and setting a dental impression to form a die model affixed to the  
19 engaging head;
- 20           (iii)   attaching the tail to the lower portion of the engaging head;
- 21           (iv)    placing the sleeve around the lower portion of the engaging head and upper  
22 and middle portions of the tail; and
- 23           (v)     casting a base to form a dental model.

24          The invention is further described in the following illustrative drawings and detailed  
25 description.

#### 26 **Brief Description Of The Drawings**

27          **FIG. 1** illustrates a conventional core aligned with a conventional implant fixture.

28          **FIG. 2** illustrates a conventional prosthetic tooth.

29          **FIG. 3** illustrates a conventional prosthetic tooth aligned with a conventional implant  
30 fixture analog.

1           **FIG. 4** illustrates the attachment of a conventional prosthetic tooth to a conventional  
2 dental model.

3           **FIG. 5** illustrates the attachment of a conventional prosthetic tooth to a conventional  
4 implant fixture embedded in a patient's mouth.

5           **FIG. 6** illustrates a kit made in accordance with the invention.

6           **FIGS. 7(A), 7(B), 7(C), 7(D), 7(E) and 7(F)** illustrate the interaction between  
7 components of the invention.

8           **FIGS. 8(A), 8(B), 8(C), 8(D) and 8(E)** illustrate steps for using the invention in  
9 conjunction with a die model and dry set dowel pins.

10           **Detailed Description Of The Invention**

11           The invention improves upon the technology described in **FIGS 1-5**. The invention  
12 also improves upon the technology described in three patents issued to the same inventor,  
13 namely, U.S. Patent Nos. 5,658,147, 5,788,494 and 5,934,906, the disclosures of which are  
14 incorporated herein by reference.

15           **FIG. 1** illustrates a conventional implant fixture **110** and core **120**. The implant  
16 fixture **110** is a hollow tubular device that contains: (1) an engaging head **111** that contains a  
17 raised abutment **112** thereon to facilitate engagement with a prosthetic tooth; (2) a threaded  
18 exterior **112** to facilitate osseointegration into a patient's jaw and prevent retrograde  
19 movement after installation; and (3) a threaded socket (not shown) that extends axially into  
20 the implant fixture **110** to facilitate reception of a screw shaft. The core **120** is a hollow  
21 tubular device that contains an engaging head **121** that contains a recess (not shown) that is  
22 proportionate to the abutment **112** on the engaging head **111** of the implant fixture **110**. The  
23 core **120** has a hollow interior **121**, open at each end **121a** and **121b**, adapted to receive a  
24 headed screw (not shown). The upper portion **122a** of the interior surface **121** of the core  
25 **120** has a relatively large diameter adapted to receive the head of a screw. The lower portion  
26 **122b** of the interior surface **121** of the core **120** has a relatively narrow diameter adapted to  
27 receive the shank of a headed screw. The upper **122a** and lower **122b** portions of the interior  
28 surface **121** of the core **120** cooperate to form a shoulder **123** for seating the head of a screw.

29           **FIG. 2** illustrates a conventional prosthesis **210** of the UCLA-type that contains two  
30 replicated teeth **220** and **221**. The prosthesis **210** comprises a core **120** (such as the core  
31 shown in **FIG. 1**) and an integrally formed abutment **230**. The abutment **230** is typically

1 formed of metal, usually gold. A ceramic facing 240, typically porcelain, is formed over the  
2 abutment 230 to replicate the dentition.

3 **FIG. 3** illustrates the alignment of a prosthesis 210 (such as the prosthesis shown in  
4 **FIG. 2**) with a conventional analog pin 310. The analog pin 310 contains an engaging head  
5 311 with a raised abutment 312 that corresponds to the abutment 112 on the engaging head  
6 111 on the implant fixture 110. The engaging head 311 facilitates engagement of the analog  
7 pin 310 with the prosthesis 210. The analog pin contains ridges 220 to facilitate bonding to  
8 dental model casting materials (not shown). A threaded socket (not shown) extends axially  
9 into the analog pin 310 to enable reception a screw (not shown).

10 **FIG. 4** illustrates a known procedure for mounting a prosthesis 210 (such as that  
11 shown in **FIG. 2**) to a dental model 410 using an analog pin 310 (such as that shown in **FIG.**  
12 **3**). The analog pin 310 is physically affixed to the dental model 410 by positioning the  
13 analog pin in casting material used to make the dental model 410 prior to setting. The raised  
14 abutment 312 on the engaging head 311 of the analog pin 310 is structured to cooperate with  
15 the recess on the engaging head 121 of the core 110 of the prosthesis 210, so that the  
16 prosthesis 210 sits on the analog pin 310 in a manner that prevents rotational movement. A  
17 headed screw 420 is passed through the core 110 in the prosthesis 210 and rotated into the  
18 threaded screw shaft of the analog pin 310 to affix the prosthesis 210 to the analog pin 310.

19 **FIG. 5** illustrates a known procedure for attaching a prosthesis 210 (such as that  
20 shown in **FIG. 2**) to a patient's jaw 510 using an implant fixture 110 (such as that shown in  
21 **FIG. 1**.) The prosthesis 210 is mounted onto the implant fixture 110 after it has been fixed  
22 into the patient's jaw 510 by the medium of osseointegration. The raised abutment 112 on  
23 the engaging head 111 of the implant fixture 100 is structured to interact with the recess on  
24 the engaging head 121 of the core 110 of the prosthesis 210 to insure that the prosthesis 210  
25 does not rotate on the implant fixture 110. A headed screw 520 is passed through the core  
26 110 in the prosthesis 210 and rotated into the threaded screw shaft of the implant fixture 110  
27 to affix the prosthesis 210 to the implant fixture 110. The exposed end 121a of the hollow  
28 core 120 of the prosthesis 210 is capped with a plug 530 of porcelain or some other material.

29 **FIG. 6** illustrates a kit 600 made in accordance with the present invention. The kit  
30 600 contains an engaging head 610, a cavity preserver 620, a tail 630, a sleeve 640 and a pin  
31 relieve 650.



1       The engaging head **610** can be divided into upper **611a**, middle **611b** and lower **611c**  
2 portions. The upper portion **611a** contains a geometric abutment **612** that surrounds a central  
3 opening **613** and mimics the abutment **112** on the engaging head **111** of an implant fixture  
4 **110**. For example, the abutment **612** may be a raised hollow hexagon. The middle portion  
5 **611b** contains an internally threaded hollow tube **614**. Preferably, the outer surface of the  
6 tube **614** contains ridges **615**. More preferably, the ridges **615a** run vertically down the outer  
7 surface of the tube **614**. The ridges **615a** provide an uneven surface which facilitates the  
8 adhesion of the engaging head **610** to casting material as it constricts during the setting  
9 process. The lower portion **611c** contains a vertical projection **616**. Preferably, the outer  
10 surface of the vertical projection **616** contains ridges **615b** and/or threads (not shown) that  
11 assist attaching the engaging head **110** to the tail **130** by adhesive and/or interlocking threads,  
12 respectively.

13       The engaging head **610** is relatively short, i.e., no more than .5 inches (i.e., .25  
14 inches) in length. Thus, the engaging head **610** is smaller than the width of typical die  
15 models, even after the die models are trimmed and leveled. Accordingly, the engaging head  
16 **610** is not damaged if it is affixed to a die model that is trimmed and leveled to permit the dry  
17 setting of dowel pins.

18       The cavity preserver **620** is a soft, hollow, tubular body, with an opening **621** on at  
19 least one end. For instance, the cavity preserver **620** may be a piece of rubber tubing. The  
20 cavity preserver **620** is generally softer and longer than the lower portion **611c** of the  
21 engaging head **610**. The function of the cavity preserver **620** is to extend away from the  
22 lower portion **611c** of the engaging head **610** and, thereby, preserve a cavity leading to the  
23 engaging head **610** during the casting, curing, grinding and trimming of a die model. The  
24 cavity preserver **620** should be soft enough that its length is easily ground and trimmed,  
25 similar to cast material. Thus, when the underside of the die model is trimmed and leveled to  
26 permit the dry setting of dowel pins, the cavity preserver **620** is also trimmed and leveled.  
27 When trimming and leveling is complete, the remnants of the cavity preserver **620** are  
28 removed and discarded. When the cavity preserver **620** is removed, a hole remains in the die  
29 model that permits access to the engaging head **610**.

30       The tail **630** is a pin structure designed to connect to the engaging head **630** to form a  
31 two part analog pin (not shown) after the initial casting, grinding and trimming of a die

1 model. The tail 630 attaches to the lower portion 611c of the engaging head 630 through a  
2 cavity in the die model that is created by the cavity preserver 620 and exposed when the  
3 cavity preserver 620 is removed. The two part analog pin, when assembled, is similar to  
4 those described in U.S. Patent Nos. 5,658,147 and 5,788,494 and 5,934,906.

5 The tail 630 is divided into upper 631a, middle 631b and lower 631c portions. When  
6 attached to the engaging head 610, the tail 630 projects away from the engaging head 610.  
7 Attachment can be accomplished by a number of means including friction fit, interlocking  
8 thread, and/or an adhesive. Preferably, the tail 630 contains an opening 632 in the upper  
9 portion 631a that facilitates attachment. The opening 632 fits around the lower portion 611c  
10 of the engaging head 610 to form a friction fit. Preferably, the fit is made more permanent by  
11 deploying an adhesive into the opening 632 before the fit is made. The ability of the adhesive  
12 to bind to the internal surface of the opening 632 may be facilitated by the incorporation of  
13 threads or ridges on the internal surface.

14 The tail 630 contains a slight surface undulation 633 somewhere on its surface. The  
15 undulation 633 is designed to interact with sleeve 640 to prevent axial movement of the two  
16 part analog pin when it is sheathed in the sleeve 640.

17 The tail 630 contains a flat 634 or equivalent structure somewhere on one side of its  
18 surface. The flat 634 cooperates with the sleeve 640 to insure that there is no rotational  
19 movement of the two part analog pin when it is sheathed in the sleeve 640.

20 Preferably, the tail 630 contains an indentation 635 on the lower portion 631c. The  
21 indentation 635 is designed to engage a pin relief 650 and, thereby, provide an additional  
22 locking mechanism to prevent unintended axial movement of the two part analog pin when it  
23 is sheathed in the sleeve 640.

24 The sleeve 640 is hollow tubular body that has an upper opening 641a and a lower  
25 opening 641b (not shown). The sleeve 640 fits around portions of the two part analog pin,  
26 e.g., around the lower portion 111c of the engaging head 610 and the upper 131a and middle  
27 131b portions of the tail 630. Preferably, the two part analog pin is sufficiently longer in  
28 axial length than the sleeve 630 to permit lower portion 631c of the tail 630 to extend  
29 through the bottom opening in the sleeve 640. This permits axial force to be exerted on the  
30 two part analog pin from below to remove the two part analog pin from the sleeve 640.

1           Surrounding the lower opening **641b** is an annular flange **642**. The annular flange  
2 **642** provides an uneven surface sufficient to affix sleeve **640** into a setting casting material.

3           The inside surface of sleeve **640** has a slight surface undulation **642** that interacts with  
4 the surface undulation **633** on the surface of tail **630**. This provides the snap connection  
5 between the two part analog pin and sleeve **640**. Axial force must be applied sufficient to  
6 move, or snap, the undulations past one another when installing and removing the two part  
7 analog pin.

8           The sleeve **640** contains a flat **643** or equivalent structure somewhere on at least its  
9 inside surface **644** (not shown), and preferably on its inside **644** and outside **645** surfaces.  
10 The flat **643** in the sleeve **640** corresponds to the dimensions of the flat **634** on the tail **630**  
11 and interacts with the flat **634** on the tail **630** to insure that the two part analog pin can only  
12 be inserted into the sleeve **640** in one direction, namely, the direction dictated when the flats  
13 align.

14           The pin relief **650** serves to further lock the two part analog pin into the sleeve **640**.  
15 The pin relief **650** has a larger diameter than both the lower portion **631c** of the tail **630** and  
16 the sleeve **640**. The pin relief **650** attaches to the lower portion **631c** of the tail **630** in a  
17 removable manner to prevent undesired axial movement of the two part analog pin within the  
18 sleeve **640**. Removable attachment may be accomplished by a number of means including a  
19 snap fit and interlocking threads. Preferably, however, attachment is accomplished by  
20 hooking the indentation **635** on the lower portion **631c** of the tail **630** into an opening **651** on  
21 the surface of the pin relief **650**.

22           **FIGS. 7(A), 7(B), 7(C), 7(D), 7(E), and 7(F)** illustrate the interaction of various  
23 components in invention. Each interaction is shown in order it generally occurs when the  
24 invention is employed.

25           **FIG. 7(A)** shows an engaging head **610** connected to a cavity preserver **620**. The  
26 opening **621** (not visible) in the cavity preserver **620** is sufficiently wide and sufficiently  
27 deep to contain the lower portion **611c** (not visible) of the engaging head **610**, but  
28 insufficiently wide and/or insufficiently deep to contain the upper **611a** and middle **611b**  
29 portions of the engaging head **610**. The cavity preserver **620** is longer than the lower  
30 portion **611c** of the engaging head **610**.

1           **FIG. 7(B)** shows an adhesive **710** being poured into an opening **632** in upper portion  
2 **631a** of the tail **630** to facilitate attachment of engaging head **610** to tail **630**. **FIG. 7(B)** also  
3 shows an engaging head **610** aligned to attach to the opening **632** in the upper portion **631a**  
4 of the tail **630**. At this point, the cavity preserver **620** has been removed from the engaging  
5 head **610**.

6           **FIG. 7(C)** shows an engaging head **610** adhered to a tail **630**. This two part structure  
7 forms analog pin **720**.

8           **FIG. 7(D)** shows the two part analog pin **720** partially inserted into sleeve **640**. **FIG.**  
9 **7(E)** shows the two part analog pin **720** fully inserted into sleeve **640**. A portion **730** of the  
10 two part analog pin **720** protrudes from the lower opening in the sleeve **640**.

11           **FIG. (7F)** shows the two part analog pin **720** fully inserted into sleeve **640**. The  
12 portion **730** that protrudes from the lower opening in the sleeve **640** rests in pin relief **650**.

13           **FIGS. 8(A), 8(B), 8(C), 8(D) and 8(E)** illustrate the various steps for using the  
14 invention in conjunction with a die model and dry set dowel pins. Each step is shown in the  
15 order it would generally occur when the invention is employed.

16           In **FIG. 8(A)**, the engaging head **610** is connected to cavity preserver **620** and die  
17 stone is then cast and set to generate a die model **810**. The upper surface **811a** of the die  
18 model **810** contains one or more replicated teeth, **820a** and **820b**, and engaging head **610**.  
19 Cavity preserver **620**, at this point, is buried in the die model **810**.

20           In **FIG. 8(B)**, the lower surface **811b** of die model **810** is trimmed and leveled in  
21 preparation for the dry setting of dowel pins. This step damages a portion of cavity preserver  
22 **620**. Engaging head **610** is not damaged in this process.

23           In **FIG. 8(C)**, cavity preserver **620** is removed using tweezers **830**. Removal of  
24 cavity preserver **620** leaves a cavity **840** in the lower surface **811b** of die model **810** that  
25 exposes the lower portion **611c** of engaging head **610**.

26           In **FIG. 8(D)**, two holes **850a** and **850b** are drilled into the lower surface **811b** of die  
27 model **810**. A dowel pin, **860a** and **860b**, is then aligned with each hole. Dowel pins **860a**  
28 and **860b** are to be affixed into holes **850a** and **850b**, respectively, by any number of means,  
29 including an adhesive. To create binding sites for an adhesive, each dowel pin usually  
30 contains a patterned upper portion **861a** and **861b**.

1 In addition, the upper portion 631a of tail 630 is aligned with the lower portion 611c  
2 of engaging head 610 in die model 810, which is now exposed by cavity 840. In turn, sleeve  
3 640 is aligned with tail 630 so that the flat 643 on the sleeve 640 is aligned with the flat 634  
4 on the tail 630. The upper portion 631a of tail 630 is to be affixed to the lower portion 611c  
5 of engaging head 610 by, for example, an adhesive, to create the two part analog pin. The  
6 two part analog pin will then be sheathed in sleeve 640.

7 In FIG. 8(E), a complete dental model 888 is shown. Dowel pins, 816a and 816b,  
8 have been attached to die model 810 and sheathed in dowel sleeves 817a and 817b. In  
9 addition, engaging head 610 and tail 630 have been connected to form a two part analog pin  
10 720. The two part analog pin 720, in turn, has been sheathed in the analog pin sleeve 640.  
11 Subsequently, a base 870 has been cast around the exposed portions of analog pin sleeve 640  
12 and dowel sleeves 860a and 860b. The base sets and, in so doing, contracts, to permanently  
13 bind the sleeves 640, 860a and 860b into the base 870. The annular flange 642 on the analog  
14 pin sleeve 640 and surface irregularities on the dowel pin sleeves assist in binding the  
15 devices to the base 870b.

16 There is a horizontal dividing line 870a between die model 810 and base 870 defined  
17 by different casting materials and/or a thin plastic divider positioned prior to casting the base  
18 870. Similarly, there are vertical dividing lines 871a and 871b that represent cuts made in  
19 the die model to permit dies 880a and 880b to be separated from the remainder of die model  
20 810. When this happens, the dowel pins 816a or 816b associated with each die 880a or 880b  
21 separates from its respective dowel sleeve 817a or 817b.

22 A portion of the tail 630 on the analog pin 720 extends outside the analog pin sleeve  
23 640. The analog pin 720 can be removed simply by applying upward axial force to the tail  
24 630. Accordingly, a prosthetic tooth 210 attached to the analog pin 720 can be easily  
25 snapped out of, and snapped into, the sleeve 640 and, thereby, the dental model 888.

26 As is apparent from FIG. 8(E), the invention permits an analog pin 720 to be set and  
27 utilized in conjunction with the setting and utilization of dry set dowel pins 816a or 816b .  
28 In addition, the invention preserves the quick snap connection capabilities of the assembly  
29 described in U.S. Patent Nos. 5,658,147, 5,788,494 and 5,934,906.

30 A method for making a dental model comprising the invention entails the following  
31 steps. First, one positions the engaging head onto a coping in a dental impression. Second,

1 one casts and sets a dental impression to form a die model affixed to the engaging head.  
2 Third, one attaches the tail to the lower portion of the engaging head, wherein said tail is  
3 comprises a pin divided into upper, middle and lower portions, and wherein said pin projects  
4 away from the engaging head. Fourth, one places a sleeve around the lower portion of the  
5 engaging head and upper and middle portions of the tail. Fifth, one casts a base to form the  
6 remainder of the dental model

7 Preferably, a method for making a dental model comprising the invention entails the  
8 following steps. First, one positions the engaging head onto a coping in a dental impression.  
9 Second, one places the cavity preserver onto the lower end of the engaging head. Third, one  
10 casts and sets a die model that affixes the engaging head. Fourth, one trims and/or levels the  
11 underside of the die model and attaches dowel pins. Fifth, one removes the cavity preserver  
12 or any remnants of the same. Sixth, one attaches the tail to the lower portion of the engaging  
13 head. Seventh, one places the sleeve around the lower portion of the engaging head and  
14 upper and middle portions of the tail. Eighth, one attaches a pin relief to the lower portion of  
15 the tail. Ninth, one casts the base to form the remainder of the dental model. Tenth, and  
16 finally, the die model is cut to form sectioned dies.

17 It should be understood that a number embodiments of the invention are possible. In  
18 addition, a number of equivalents may exist which remain consistent with the heart of the  
19 invention. Accordingly, the scope of the invention for which protection is sought is defined  
20 by the following claims and any equivalents thereof.

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